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Pacific Herring Stocks and Fisheries in the Arctic-Yukon-Kuskokwim Region of the Bering Sea, Alaska, 1996

A Report to the Alaska Board of Fisheries

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INTRODUCTION

The objectives of this report are to summarize the results of the 1996 Pacific herring stock assessment programs of the Arctic-Yukon-Kuskokwim (AYK) Region, review 1996 harvests and management strategies of all AYK commercial and subsistence herring, and present general management strategies planned for the AYK herring fishing season in 1997. Commercial fishing districts included in this report consist of the Security Cove, Goodnews Bay, Cape Avinof, Nelson Island, Nunivak Island, Cape Romanzof, Norton Sound, and Port Clarence Districts (Figures 1 and 2).

The Alaska Board of Fisheries established threshold biomass levels, below which harvests are not allowed under the Bering Sea Herring Fishery Management Plan (5 AAC 27.060, ADF&G 1996), for all districts with the exception of the Port Clarence District. Exploitation rates are limited to a maximum of 20% in all areas. In some areas, the Board of Fisheries has further restricted exploitation rates to protect subsistence harvests. All herring AYK districts open and close by Emergency Order authority to provide for an orderly fishery and allow periodic assessment of herring biomass. Fishing effort has been limited by a moratorium which was placed on entry into the Nelson Island, Nunivak Island, Cape Romanzof, and Norton Sound herring fisheries in 1987. In addition, all AYK Region commercial herring districts, except Security Cove and Port Clarence, are designated as superexclusive use areas.

A total biomass of 61,822 tons of herring was estimated to have been present in the surveyed portion of the AYK Region herring districts in 1996 (Tables 2 and 5). The 1996 return is 20% below the 5-year average (1991-1995) of 74,124 tons. Ages 8 and 9 combined comprised 35% to 50% of the biomass for all districts with the exception of Nunivak Island. Ages 6 and 8 dominated the Nunivak Island biomass (46.3%). With the exception of Goodnews Bay, recruitment, in all Kuskokwim districts, was weaker than in 1995. In these districts, recruits, ages 2 through 5, comprised 23% to 29% of the return in numbers of fish. Goodnews Bay recruits represented 28% of the return, which is a slight increase over 1995. Relatively little recruitment was observed in either the Norton Sound or Cape Romanzof Districts (18% and 13%, respectively).

The 1996 herring harvest for the AYK Region was approximately 11,986 tons with an estimated exvessel value of $8,730,000 (Tables 1 and 2). This represents an increase in both harvest and value compared to 1995 levels of 11,299 tons and $7,433,000 and is primarily due to record harvests in Security Cove, Goodnews Bay, Cape Avinof, and near-record harvests at Norton Sound and Nelson Island. The harvest is nearly twice the 5-year average (1991-1995) of 6,522 tons and the value is nearly three times the 5-year average of $2,944,000 (Table 2). The price paid to fishermen in AYK fishing districts for herring with 10% roe content was approximately $600 per ton in the Kuskokwim Area, $800 per ton in the Cape Romanzof District, and $650 per ton in the Norton Sound District plus or minus $60 a percentage point, and $50 per ton for bait-quality herring. Theses prices are slightly higher than in 1995. Food and bait sales during the sac roe fishery totaled

266 tons, with the remaining harvest sold as sac roe product. Harvest identified as food and bait primarily occurs during the sac roe fisheries when fish are sold with a roe content that is below buyer's acceptable minimums. In some years, wastage occurs when fishermen abandon gillnets or cannot sell their catch. This amount is added to the total harvest and is included in calculations of exploitation rates. In 1996, 55 tons of herring were discarded (Table 2).

A total of 1,152 fishermen participated in AYK sac roe herring fisheries during the 1996 season (Table 3). This is the highest effort on record. Effort had been declining in recent years as fishermen have been discouraged by both low prices and fewer buyers than in previous years. There was no herring fishery in the Port Clarence District during the sac roe season in 1996. There has not been a commercial sac roe fishery in the Port Clarence District since 1988 due to a lack of buyers. In most years, there has been a small bait fishery in the Port Clarence District.

Surveyed subsistence fishermen from selected Yukon-Kuskokwim River Delta villages harvested approximately 98 tons of herring (Table 4).

Roe recoveries in the sac roe harvest ranged from 9.9% in the Nunivak Island District to 13.4% in the Cape Avinof District, with a combined regional roe recovery of 11.2%. An awareness among processors, managers and fishermen of the poor market conditions and the need for a high-quality product helped produce high roe percentages again this year. Managers attempted to limit period harvests to an amount that could be processed within three days. The 1996 total exploitation rate for the AYK Region was 19.4%. Exploitation rates ranged from 2.4% in the Nunivak Island District to 27.1% in the Security Cove District (Table 2).

Biomass projections for each district using postseason escapement estimates, historic mean rates of survival, current mean weights for each age class and estimates of recruitment for each age class (Wespedstad 1982), suggest that the 1997 spawning biomass for the northeastern Bering Sea herring stocks (Security Cove to Norton Sound) will be approximately 46,192 tons with a projected harvest of 8,962 tons (Table 7). This is a decline from the 1996 biomass of 61,822 tons. Districts with projected declines are either those with poor aerial survey conditions in 1996 or those in which a slight decline is expected as the predominant year class ages. These projections do not include age classes not yet seen in the fishery.

Variability in survival rates and in aerial survey assessments of biomass and deviations from the assumed survival or recruitment rates may result in the observed biomass being either above or below these projections. Harvest levels will be adjusted during the season according to observed herring spawning biomass. In addition, in accordance with the AYK Region harvest policy, newly recruited age classes will not be targeted by the commercial fishery. If it is not possible to determine herring abundance using aerial survey methods, stock abundance will be assessed using information from the projected biomass, test and commercial catches, and spawn deposition observations.

STOCK STATUS

Assessment Methods

The timing of the spawning migration of herring in the northeastern Bering Sea is greatly influenced by climate and oceanic conditions, particularly the extent and distribution of the Bering Sea ice pack. Most herring appear soon after ice breakup, which generally occurs between late-April and mid-June. Spawning usually begins in the Security Cove District and generally progresses in a northerly direction. In some areas, spawning may continue as late as July.

Aerial survey techniques have been used since 1978 in Bering Sea herring fisheries to estimate herring spawning biomass (Lebida and Whitmore 1985). However, it is often difficult to obtain biomass estimates from aerial surveys in the AYK Region because of poor survey conditions caused by unfavorable weather, ice conditions or turbid water. Herring school surface areas are recorded in 538 ft^2 relative abundance index (RAI) units. In the AYK Region, RAI units are converted to biomass based on water depth. Because purse seine gear is needed to estimate the conversion factors, and purse seine gear is not fished in the AYK Region, conversion factors were estimated from sampling performed in the Togiak District. Ground surveys are conducted in some districts to obtain information on the distribution and density of kelp beds and herring spawn deposition.

During 1996, 87 aerial surveys totaling 79.7 hours of flight time were flown in the AYK Region: 11 (5.8 hours) in Security Cove, 12 (8.5 hours) in Goodnews Bay, 5 (3.6 hours) in Cape Avinof, 11 (3.8 hours) in Nelson Island, 10 (14.0 hours) in Nunivak Island, 5 (1.1 hours) in Jacksmith Bay, 9 (5.1 hours) in Cape Romanzof, and 24 (37.8 hours) in Norton Sound and Port Clarence combined. Only eighteen of these surveys were rated as being acceptable.

Gillnets are the only legal gear in the AYK Region with the exception of Norton Sound, where a portion of the harvest is taken by beach seine. An attempt was made to sample at least 420 herring from each commercial gear type, district or subdistrict per week. The sampling goal for test fish catches was to sample a minimum of 60 herring per day or 420 per week from each district or subdistrict. Herring from test fish and commercial catches were sampled in all but the Port Clarence District to estimate age, sex, size, and sexual maturity of herring and to note the occurrence of other schooling fishes. A total of 16,270 herring from commercial, subsistence and test catches were sampled during the 1996 fishing season.

In most districts, fishermen, in cooperation with the department, provided catch samples for roe quality evaluation by industry representatives. Participation by fishermen in collecting samples, processor evaluation of samples, and the flexibility of fishermen to fish on short notice helped to increase roe recoveries.

Spawning Populations

Security Cove District

Since 1981, the estimated biomass of herring in the Security Cove District has ranged from 2,300 tons in 1987 to 8,267 tons in 1981 (Table 5). During the 1996 season, eleven aerial surveys were flown in the district between May 1 and May 17 to estimate herring biomass and observe spawning activity. Seven of these surveys were flown under acceptable conditions. On May 13, 5,008 tons of herring were observed during an aerial survey. The total biomass estimate for the Security Cove District of 6,867 tons was calculated by combining the May 13 aerial survey estimate and the commercial harvest. A total of 19.7 miles of spawn was observed in the district with peak spawning activity (6.0 miles) on May 10.

The Security Cove test fish crew sampled 1,556 fish caught with variable mesh gillnets from May 7 to May 29 for biological data. Ages 8 and 9 dominated the biomass (24.0% and 23.3% respectively; Figure 5) and the return in numbers of fish (21.3% and 17.5% respectively). Age 9 and older herring comprised 42.4% of the biomass. Recruit herring represented 24.7% of the return in numbers of fish (Figure 7).

Goodnews Bay District

Since 1981, the estimated biomass of herring in the Goodnews Bay District has ranged from 2,000 tons in 1987 to 6,315 tons in 1996 (Table 5). During the 1996 season, twelve aerial surveys were flown in the district between May 1 and June 4. Six surveys were flown under acceptable conditions. On May 8, 4,482 tons were observed during an aerial survey. During a survey on May 17, 4,488 tons were observed. The Department's test fish crew documented spawning activity on May 6. The total biomass estimate of 6,315 tons was calculated by adding fish seen on the May 17 survey that were not present on May 8. Two and one-half miles of spawn were observed during aerial surveys of the district.

The Department's test fish crew sampled 1,439 herring caught with variable mesh gillnets from May 6 to May 29 for biological data. Ages 8 and 9 dominated the return in biomass (24.3% and 18.8%, respectively) and ages 5 and 8 dominated the return in numbers of fish (22.2% and 21.8%, respectively). Age 9 and older herring comprised 41.5% of the biomass. Recruit herring represented 28.5% of the return in numbers of fish (Figure 7).

Cape Avinof District

Aerial surveys have been conducted by the department in the Cape Avinof area since 1985 and biomass estimates have ranged from 1,225 tons in 1987 to 4,500 tons in 1996 (Table 5). During 1996, five surveys were flown in the Cape Avinof District from May 19 to June 2. Only one of these was flown under acceptable aerial survey conditions. During an aerial survey on June 2,

1,276 tons of herring were observed. Aerial survey estimates of herring biomass in the Cape Avinof District have only been successful in four of the past ten years. The last year in which the herring biomass was estimated by survey was in 1992 when 3,446 tons were observed. In other years, the preseason projection or commercial catch rates have been used for estimating herring biomass. The area consists of shallow mud flats. Water turbulence caused by wind and wave action obscures visibility of the bottom through the water column. Catch rates in 1996 were the highest in the history of the fishery. Local fishermen and the Department's test fishing crew noted a high abundance of herring as indicated by spawn deposition, catchability and comments from local residents, as compared to previous years. An estimate of the 1996 Cape Avinof herring biomass of 4,500 tons was made post-season based on the estimated proportion harvested.

The Cape Avinof test fish crew sampled 1,245 herring caught with variable mesh gillnets from May 18 to June 5 for biological data. Age 8 dominated the biomass (24.4%) and age 6 dominated in numbers of fish (22.6%). Age 9 and older herring comprised 29.9% of the biomass. Recruit herring represented 28.9% of the returning population (Figure 7).

Nelson Island District

Since 1985, biomass estimates of herring in the Nelson Island District have ranged from 2,385 tons in 1991 to 9,500 tons in 1985 (Table 5). In 1996, eleven aerial surveys were flown in the Nelson Island area between May 12 and June 2. Only two of these surveys were made under acceptable conditions. During a survey flown on May 15, 1,350 tons of herring were observed in the district. Since there were no acceptable surveys after May 15, the preseason forecasted biomass of 6,638 tons was used as the total biomass estimate for 1996. A total of 3.4 miles of spawn was observed during aerial surveys of the district. Peak spawning was observed on May 15 when 1.6 miles of spawn were sighted.

Test fishing with variable mesh gillnets occurred from May 19 through June 13. The crew sampled 1,899 herring caught in variable mesh gillnets for biological data. Age 8 dominated the returning biomass (22.6%, Figure 5) and ages 6 and 8 dominated in numbers of fish (20.4% and 21.1%, respectively). Age 9 and older herring comprised 44.8% of the biomass. Recruit herring represented 23.4% of the spawning population (Figure 7).

Nunivak Island District

Since 1985, the estimated biomass in the Nunivak Island District has ranged from 422 tons in 1990 to 6,000 tons in 1986 (Table 5). In 1996, ten aerial surveys were flown in the Nunivak Island District between May 12 and June 2. Only one of these was rated as acceptable. During an aerial survey on May 14, 805 tons of herring were observed. During a survey on May 24, 494 tons of herring were observed. Total biomass in the district was estimated to be 4,195 tons based on the projected return from the 1995 escapement. About 3.9 miles of spawn were observed during aerial surveys with peak spawning (1.1 miles) occurring on May 12. An industry spotter pilot reported seeing approximately 5.3 miles of spawn on May 13.

Test fishing with variable mesh gillnets occurred from May 12 through June 4. The Department's test fish crew sampled 1,054 herring caught in variable mesh gillnets for biological data. Ages 6 and 8 dominated the biomass (22.8% and 23.5%, respectively) and age 6 dominated the return in numbers of fish (27.6%; Figure 6). Age 9 and older herring comprised 31.4% of the biomass. Recruit herring represented 25.3% of the spawning population (Figure 7).

Cape Romanzof District

Due to excessive water turbidity in the Cape Romanzof area, it is generally not possible to estimate herring biomass using aerial survey techniques. Based on information from limited aerial surveys, test and commercial catches, spawn deposition, and comparisons with other herring spawning areas of similar size, the Cape Romanzof District herring biomass is estimated to be between 3,000 and 8,000 tons. Nine aerial surveys were flown during the 1996 season from May 14 through June 4. A total of 5.1 hours were spent surveying the district. None of these surveys were flown under acceptable survey conditions. The largest quantity of herring observed during an aerial survey was 401 tons on May 22. Based on spawn deposition study results and herring age composition, the 1996 biomass of herring in the Cape Romanzof District was estimated postseason to be 6,000 tons.

A quantitative spawn deposition project, using platforms covered with an artificial spawning substrate, was conducted from May 14 until June 7. The spawn deposition study area location was the same as in 1992 through 1995. Spawn deposited on the substrate was removed and weighed daily at low tide. Daily removal of spawn allowed measurements of new spawn deposition and decreased the problem of spawn loss due to wave action and desiccation observed in previous studies. The largest spawn depositions within the study area occurred on May 14, 23, and 24. The spawn deposition index of 5,599 g obtained this year was the largest since the study was initiated in 1992. The spawn deposition index was 2,470 g in 1992, 3,454 g in 1993, 4,056 g in 1994, and 4,985 g in 1995. Although there is a trend of increasing spawn deposition, it is unknown whether the study area results are indicative of the total spawning biomass within the entire district.

The Department's test fish crew at Cape Romanzof caught 1,675 herring from May 14 through June 6 with variable mesh gillnets of which 1,083 were sampled for biological data. Age 8 herring dominated the return in both biomass (30.8%) and numbers of fish (30.6%). Age 9 and older herring comprised 48.5% of the biomass (Figure 6). Recruit herring represented 12.9% of the spawning population (Figure 7). Typically, recruit herring arrive late in the spawning run and are primarily present in Scammon Bay. No test fishing was conducted in Scammon Bay in 1996 because of poor weather conditions.

Norton Sound District

Historically, the primary spawning areas within Norton Sound have been from Stuart Island to Tolstoi Point. Additional spawning areas have been documented along Cape Denbigh and several bedrock outcroppings along the northern shore of Norton Sound between Bald Head and Topkok, especially in years when sea ice has remained in the nearshore areas into June.

Since 1978, herring biomass estimates in the Norton Sound District have ranged from 5,291 tons in 1978 to 57,974 tons in 1992. During 1996, 24 surveys were flown between May 13 and June 13. Aerial survey conditions were rated from poor to unsatisfactory during the 1996 herring season. No surveys were flown under acceptable survey conditions. Herring were first sighted during an aerial survey on May 16 and a heavy spawn was first observed on May 22. The 1996 herring biomass for Norton Sound of 26,596 tons was calculated by combining the peak aerial survey of 20,376 tons with the commercial catch and the 50 tons of estimated wastage. The Norton Sound biomass estimate was changed postseason to the projected biomass of 27,307 tons since the peak survey was flown in unacceptable conditions.

Two Department test fish projects were operational during the 1996 season. One crew operated towards the northern portion of Norton Sound at Cape Denbigh and the second crew was stationed in the southern end of the district at Klikitarik. Test fishing was conducted in the Unalakleet area as time allowed. Test fish crews sampled 2,621 herring caught with variable mesh gillnets from May 21 through June 9 for biological data. Age 8 herring comprised 37.2% of the biomass and 34.4% of the return in numbers of fish. The biomass consisted of 37.3% age 9 and older herring (Figure 6). Recruit herring represented 17.7% of the return in numbers of fish (Figure 7).

Port Clarence District

Generally, it is not possible to survey this district due to ice, water stain, and poor weather. In addition, it is difficult to identify herring due to the large numbers of saffron cod, whitefish, and other pelagic species typically present in the area. A record biomass for this district of 1,652 tons was sighted during an aerial survey in 1992. In 1996, three aerial surveys were flown in the district, but no herring were spotted.

SUBSISTENCE FISHERY

Pacific herring are an important component of the diet of residents of many Yukon-Kuskokwim Delta villages. Surveys of subsistence harvests have been conducted annually in Yukon Delta villages and sporadically in Kuskokwim Delta villages since 1975.

Extensive subsistence surveys have been conducted in most years since 1990 by Subsistence Division in the Nelson and Nunivak Island Districts in the Kuskokwim Area (Pete 1990, 1991, 1992, 1993). A total of 95 tons of herring was harvested for subsistence by 96 Nelson Island fishing families in 1996 (Table 4) (Mary Fogerty, Alaska Department of Fish and Game, Bethel, personal communication). No herring subsistence surveys were conducted on Nunivak Island in 1996.

A total of 420 herring were sampled from the subsistence catch for biological data. Age 6 herring dominated (34.7%) the subsistence harvest. The catch consisted of 16% age 9 and older herring and 17.8% recruit-aged herring.

During 1996, a subsistence harvest of 2 tons was estimated to have been taken by 17 fishing families from the Yukon Delta villages of Hooper Bay, Chevak, and Scammon Bay (Table 4). In addition, 386 pounds of spawn-on-kelp (*fucus*) were harvested for subsistence use by 10 families. A combination of mail-out questionnaires and personal interviews were used to collect subsistence harvest information. A total of 64 fishing households were contacted out of a total of 221 identified households. The subsistence catch figures represent only the harvest which was reported. Therefore, the reported harvest is a minimum estimate since not all families were contacted and not all families who received questionnaires returned them.

COMMERCIAL FISHERY

Security Cove District

In 1996, fishermen harvested 1,859 tons of herring in two commercial periods totaling 5.5 hours of fishing time (Table 6).

The fishery opened May 11 for two hours resulting in a catch of 379 tons of sac roe quality herring with an average roe content of 11.4% and 32 tons of bait herring. Two hundred seventy-seven permit holders participated in this first opening. The second opening occurred on May 12 for 3.5 hours. The harvest quota was exceeded when catch rates increased dramatically with 307 permit holders delivering 1,417 tons of sac roe quality herring with an average roe content of 11.6% and 26 tons of bait herring.

During the 1996 herring season, 14 processors bought herring from 326 permit holders who made 601 deliveries. The catch consisted of 1,854 tons of sac roe herring with an average roe recovery of 11.6% and an estimated 5 tons of discarded herring. The harvest was worth $1,251,000 to fishermen. The exploitation rate was 27.1%.

A sample of 420 herring was taken from the commercial catch. Age 8 herring comprised the largest age group (34.0%) in the harvest biomass. Age 9 and older herring made up 59.7% of the catch by weight (Figure 5). There were no recruit-age herring in the commercial sample.

Goodnews Bay District

In 1996, 1,204 tons were harvested in eleven commercial periods for a total fishing time of 44.0 hours (Tables 1, 2 and 6).

A meeting with fishermen and processors was held on May 15. Commercial fishermen brought catch samples to the meeting for evaluation by industry roe technicians. Roe content of commercial test fish samples averaged 10.8%. The fishery first opened on May 16 for 4 hours. Forty-six permit holders delivered 71 tons of sac roe herring with an average roe content of 11.7%. During a four hour period on May 17, 366 tons of herring were caught. High winds and rough seas significantly reduced effort and catch rates in most commercial periods.

The catch consisted of 1,191 tons (Table 2) of sac roe quality herring with an average roe content of 12.5% and 13 tons of bait-quality herring. Period catches ranged from 23 tons on May 23 to 366 tons on May 17. During the fishery, roe contents ranged from 11.4% to 13.9%. Five processors bought herring from 182 permit holders who made 1,186 deliveries with an estimated exvessel value of $895,000 (Tables 2 and 3). The exploitation rate was 19.1% of the available biomass.

A sample of 475 herring was taken from the commercial catch. The largest age class in the harvest was age 8 (31.7%). Age 9 and older herring made up 60.5% of the catch (Figure 5). Recruit herring comprised less than 1% of the harvest.

Cape Avinof District

In 1996, 820 tons of herring were harvested during eleven commercial openings for a total fishing time of 55 hours (Tables 1, 2, and 6).

Between May 19 and May 21, commercial fishing occurred only in the southern half (defined as waters east of Kwigluk Island) of the district. Ice conditions did not allow commercial fishing in the northern half of the district until May 22.

The southern half of the district was first opened to commercial fishing for six hours on May 19. The harvest was six tons of sac roe herring with an average roe content of 13.3%. Twenty-five permit holders made deliveries. Between May 19 and May 21 the southern half of the district was reopened five times for 22 hours of fishing time. Catches ranged from 1 ton on May 20 to 11 tons on May 21. Roe contents ranged from 12.8% to 14.6%. Between May 22 and May 24, commercial fishing occurred in both the northern and southern halves of the district. In the southern half, the harvest was 10 tons on May 23 and 7 tons on May 24. There was no commercial harvest in the southern half of the district after tenders left the area on May 24. A total of 46 tons of sac roe herring with an average roe content of 13.5% were caught in the southern half of the district.

The first opening in the northern part of the district occurred on May 22 for 6 hours when 83 permit holders landed 59 tons of herring with an average roe content of 13.4%. Between May 23 and May 26 the district was reopened 4 times for 21 hours of fishing time. Catches ranged from 101 tons on May 25 to 285 tons on May 24. Average roe contents ranged from 12.4% to 14.5%. A total of 774 tons of sac roe quality herring with an average roe content of approximately 13.4% were caught in the northern half of the district.

A total of 820 tons of sac roe herring with an average roe content of 13.4% were caught. In the Cape Avinof District, 161 fishermen made 833 deliveries with an exvessel value of $659,000 to two processors (Tables 2 and 3). The exploitation rate was 18.2% of the available biomass.

Eight hundred and seventy-one herring were sampled from the commercial catch. Age 9 herring dominated the harvest (24.8%). Age 9 and older herring made up 73.5% of the catch (Figure 5). Recruit herring comprised less than 1% of the harvest.

Nelson Island District

During the 1996 season, 986 tons of sac roe-quality herring with an average roe content of 11.4% and 44 tons of bait were harvested. The fishery consisted of five commercial openings from May 16 to May 18 for a total fishing time of 25.0 hours (Tables 1, 2 and 6).

The first opening was for five hours on May 16. A harvest of 166 tons with an average roe content of 10.6% and 13 tons of bait was taken by 72 permit holders. The second opening was for four hours beginning on May 16. Thirty-seven permit holders landed 78 tons of sac roe herring with an average roe content of 11.0% and 2 tons of bait. The next commercial period was on May 17 for 5 hours. Catch from this period totaled 179 tons of sac roe herring with a roe content of 11.5% and 2 tons of bait. On May 17, 322 tons of sac roe herring with 11.6% roe recovery and 19 tons of bait were harvested. The final period of the season lasted 5 hours on May 18. Ninety-two permit holders delivered 242 tons with an average roe content of 11.9% and 8t tons of bait (Table 6).

The total catch of 1,030 tons had an average roe content of 11.4%. Three processors paid approximately $679,000 to 109 permit holders (Tables 2 and 3). The exploitation rate was 15.5% of the available biomass.

A total of 424 herring were sampled from the commercial catch. Age 9 herring dominated the harvest (22.4%). Age 9 and older herring made up 79.3% of the catch (Figure 5). Recruit herring comprised less than 1% of the harvest.

Nunivak Island District

Commercial fishing for herring in the Nunivak Island District began in 1985. The Nunivak Island District had six commercial herring periods in 1996 for a total fishing time of 254 hours. Twenty-four fishermen harvested 61 tons of sac roe herring with an average roe content of 9.9% and 40 tons of bait (Table 2).

The district was opened for five periods from May 14 to May 24. On May 27 the fishery remained opened continuously until June 5. The season ended after processors left the area on June 3. Two processors purchased $39,000 worth of herring from 24 permit holders. The exploitation rate was 2.4% of the biomass.

A total of 663 herring were sampled from the commercial catch. Recruit herring comprised less than 1% of the harvest. Age 8 herring dominated (20.4%) the harvest. Herring aged 9 and older comprised 74.6% of the catch sample by weight (Figure 6).

Cape Romanzof District

A total of 752 tons of herring were harvested by 63 fishermen utilizing 63 fishing vessels in 1996 (Tables 1, 2 and 3). The commercial harvest was 55% above the recent five-year-average (1991-1995) of 485 tons. A total of 750.3 tons were purchased as sac roe with an average sac roe recovery of 10.6% and 1.4 tons as bait. The sac roe recovery is the highest on record for this district. The commercial fishery consisted of 10 periods between May 17 and May 25. Fishing periods ranged from 1.0 hours to 6 hours in duration for a total fishing time of 34 hours. Poor weather conditions existed during most of the fishery with very low effort and harvest during periods one, three, five, and six because of high winds. Fishing gear was restricted to one 50-fathom gillnet per vessel throughout the commercial season.

The commercial harvest was allowed to exceed the preseason harvest projection of 683 tons after spawn deposition and age composition information indicated a larger biomass than projected. Buyers reported roe recovery and sex ratio information obtained from deliveries during fishing periods to determine if periods could be extended. This information was used during the sixth, and tenth periods to extend fishing time. The exploitation rate was 12.5% of the postseason biomass estimate of 6,000 tons.

Estimated value of the harvest to fishermen was $638,000, which is the largest value since 1988. Fishing effort increased in 1996 compared to the low number of fishermen documented from 1993 through 1995. Local Alaskan residents of Chevak, Hooper Bay, and Scammon Bay accounted for 95% (60 permits) of the effort and 96% (720 tons) of the harvest. Three companies purchased herring. These companies were represented by one processing vessel and seven tenders during the fishery (Table 3).

A total of 650 herring were sampled from the commercial harvest. Age 8 herring dominated the harvest (24.1%). Age 9 and older herring made up 73.1 % of the catch (Figure 6). No recruit-age herring were observed in the commercial sample.

Norton Sound District

The 1996 Norton Sound herring fishery opened by emergency order on May 24. During the sac roe season, there were two gillnet openings for a total fishing time of 14.0 hours and one beach seine opening for a total of 3.0 hours of fishing (Table 6). An educational opening was announced this year to occur on May 30, but did not occur due to poor weather and the processors leaving the district. The total harvest during the sac roe fishery was approximately 6,220 tons of herring. The catch consisted of 6,061 tons of sac roe herring, 109 tons of bait-quality herring and 50 tons of wasted herring. Since 1982, catches, including waste, have averaged 4,663 tons.

A total of 287 fishermen made at least one delivery during the season (Table 3). This is the greatest number of participants since the 1990 season. The large fishing effort this year is in part because of the record harvest during the 1995 season. During the 1996 season, 281 fishermen used gillnets to harvest a total of 5,581 tons (Tables 3 and 6). The harvest consisted of 5,472.5 tons of sac roe-quality herring with an average sac roe recovery of 10.8%, and 109 tons of bait. Eight fishermen participated in the beach seine fishery, but only six made deliveries, landing 588.9 tons of herring. The average sac roe recovery for beach seine caught herring was 9.2%. Table 8 compares historic beach seine and gillnet commercial catches in the Norton Sound District.

The commercial fishery was managed using the preseason projected harvest of 5,461 tons since the peak aerial survey did not occur until May 27. The harvest rate was estimated to be 22.8% or 759 tons above the harvest guideline of 20%.

The average sac roe recovery for all gear types was 10.6% (Table 2). The total value of the herring harvest to Norton Sound fishermen was approximately $4,569,275. Ten companies registered 12 processors and 61 tenders to operate in Norton Sound (Table 3).

A total of 1,339 herring were sampled from the commercial harvest. Age 9 and older herring, comprised (53.1%) of the gillnet harvest. The harvest was dominated by age 8 herring (46.1%). Age 8 herring comprised 39.8% of beach seine catches. There was less than 1% recruit-aged herring in the gillnet sample and recruits comprised only 9.4% of the beach seine sample.

Port Clarence District

There has not been a commercial sac roe fishery in the Port Clarence District since 1988 because buyers have not been present in the district. A small bait fishery with a harvest less than 10 tons exists in most years. In 1996, three gillnet and one beach seine fishermen harvest 5,446 pounds (2.7 tons) of bait from June 7 to June 19. Fishermen were paid 40 cents per pound.

ENFORCEMENT

The Division of Fish and Wildlife Protection (FWP) was present in most AYK herring districts this year. At least ten people from FWP using the P/V Walstad, two supercub aircraft, a Cessna 185, a R-22 helicopter and a FWP skiff were involved with the Kuskokwim area fisheries. Details on the number and type of violations observed are not available from Fish and Wildlife Protection at this time. One FWP officer was present at Cape Romanzof during the ninth commercial herring fishing period. No citations were issued. Enforcement in Norton Sound consisted of five single engine aircraft (two supercubs on wheels, one supercub on floats, and a C-185 on wheels) and a small boat. Personnel consisted of four permanent full-time FWP officers and a USFWS agent. FWP officers patrolled the fishery during each opening and closure. Eleven citations were issued for fishing

during a closed period and one was issued for no vessel numbers visible. Approximately 14 tons of herring were seized by the State of Alaska during the 1996 season.

OUTLOOK AND MANAGEMENT STRATEGY FOR 1997

Projections from post-season escapement estimates, using historic mean rates of survival and current mean weights for each age class, and estimates of recruitment for each age class (Wespedstad 1982), suggest that the 1997 spawning biomass for the northeastern Bering Sea herring stocks (Security Cove to Norton Sound) will be approximately 46,192 tons with a projected harvest of 8,962 tons (Table 7). If the return is as expected, a moderate reduction in biomass will be observed in all districts. However, variability in the quality of aerial survey assessments of biomass and deviations from the assumed survival or recruitment rates may result in the observed biomass being either above or below these projections. Therefore, harvest levels will be adjusted during the season according to observed herring spawning biomass. In addition, in accordance with the AYK Region harvest policy, newly recruited age classes (age 2 through 5 year-old-herring) will not be targeted by the commercial fishery. If it is not possible to determine herring abundance using aerial survey methods, stock abundance will be assessed using information from the projected biomass, test and commercial catches and spawn deposition observations. In all districts, the Department will work together with fishermen and buyers during the 1997 season to optimize roe recovery.

Security Cove District

The 1997 projected return to the Security Cove District is 4,625 tons. A 20% exploitation rate would result in a harvest of 925 tons (Table 7). A larger catch may occur if the 1997 biomass assessment is greater than the projection. Commercial fishing will not be allowed until the observed biomass reaches 1,200 tons or significant spawning activity is observed. The occurrence and length of fishing periods will depend on stock strength, fishing effort, and spawning activity.

Ages 6, 7, and 9 herring are expected to comprise well over one-half of the biomass. Age 9 and older herring are expected to comprise over one-third of the biomass.

Goodnews Bay District

The management strategy for this district will be similar to that planned for Security Cove. The season will open and close by emergency order when a biomass of 1,200 tons is observed or spawning activity occurs. The 1997 projected return of herring to the Goodnews Bay District is 4,752 tons. A 20% exploitation rate would result in a harvest of 950 tons (Table 7). A larger catch may occur if the 1997 biomass assessment is greater than the projection.

Ages 6 and 9 herring are expected to comprise nearly one-half of the biomass. Age 9 and older herring are expected to comprise approximately one-half of the biomass.

Cape Avinof District

Either significant spawning activity or a biomass of 500 tons must be observed before the commercial herring season can be opened. The season will open and close by emergency order. The projected 1997 biomass for the Cape Avinof District is 3,737 tons (Table 7). The exploitation rate will be no greater than 15% because of the limited data base for this area and the priority of subsistence fishing. Assuming a 15% commercial exploitation rate, the projected harvest would be 561 tons of herring.

Age 6, 7 and 9 herring are expected to dominate the returning population. Age 9 and older herring are expected to comprise approximately 40% of the biomass.

Nelson Island District

In the Bering Sea Herring Fishery Management Plan, the Alaska Board of Fisheries set a minimum biomass threshold of 3,000 tons necessary for a commercial herring fishery in the Nelson Island District. The inseason estimate of herring biomass must exceed the threshold level before a commercial fishery can be allowed.

The spawning biomass projected to return to the Nelson Island District in 1997 is 5,094 tons (Table 7). At an exploitation rate of 15%, the harvest will be 764 tons of herring. A larger catch may occur if the 1997 biomass assessment is greater than the projection.

Age 9 and 7 are expected to be the dominant age groups in the return. Age 9 and older herring are expected to comprise over one-half of the biomass in 1997.

To provide additional protection for the subsistence harvest of herring, the following guidelines will be observed:

1. The commercial fishery will not be allowed to take more than 15% of the herring biomass, compared to up to 20% for most other fisheries having stocks of similar size and condition.

2. Periodic closures of the commercial fishery will be scheduled, during which time only subsistence fishing will be allowed.

3. Several important subsistence use areas occur throughout the district, including the waters around Cape Vancouver. Specific areas may be closed to commercial fishing to insure the adequacy of subsistence harvests.

4. The department will by all available means, including input from local residents, insure the adequacy of subsistence herring harvests during the commercial fishing season.

Nunivak Island District

The projected biomass of herring returning to the Nunivak Island District in 1997 is 3,801 tons. A 20% exploitation rate would result in a 760 ton harvest (Table 7). A larger catch may occur if the 1997 biomass assessment is greater than the projection. The commercial season will open when the biomass reaches 1,500 tons or when significant spawning is observed.

Age 7 and 9 are expected to be the dominant age groups. Age 9 and older herring are expected to comprise approximately 44 % of the return.

Cape Romanzof District

The projected return for 1997, based upon limited data, is 4,508 tons, which would result in a 902 ton harvest at a 20% exploitation rate (Table 7). It is likely that fishing gear will be restricted to no more than 50 fathoms and one gillnet per vessel by emergency order. Typically aerial biomass assessment cannot be used to determine the opening of commercial fishing because of poor survey conditions caused by turbid water. Therefore, spawn deposition observations and test and commercial catch rates will be used to determine timing and duration of commercial fishing periods. If stock abundance is judged to be lower or higher than the projection, the projected harvest of 902 tons will be modified accordingly. Age 9 herring are expected to dominate the biomass. Age 9 and older herring are expected to comprise approximately two-thirds of the return.

Norton Sound District

The biomass projected to return to Norton Sound in 1997 is 19,675 tons. A 20% exploitation rate would result in a harvest of 3,935 tons (Table 7). Age 9 herring are expected to comprise 36% of the returning biomass. Age 9 and older herring are expected to comprise nearly two thirds of the biomass.

Inseason assessment of herring biomass will supersede projected biomass for management of the Norton Sound herring fishery, except where weather prevents obtaining an inseason estimate. The beach seine harvest is, by regulation, 10% of the projected harvest, or 394 tons.

The 1997 herring fishery will be opened by emergency order. The fishery will close by emergency order when up to 20% of the available herring biomass has been harvested. Varied harvest rates may be applied to individual subdistricts based on biomass distribution, roe quality, weather, and sea ice conditions.

Port Clarence District

The department does not generally project an outlook for the Port Clarence fishery due to the lack of data on Port Clarence herring and the very limited scope of the fishery. The guideline harvest of 165 tons established by the Board of Fisheries in 1981 will determine the allowable harvest in 1997. This harvest guideline is based on two years research by the department in both the Port Clarence and Kotzebue Districts. Even though this guideline has not appeared in the regulation book since 1984, it still represents the best estimate of harvestable biomass at this time.

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Table 1. Pacific herring harvests by domestic commercial fishermen during the sac roe fisheries in the northeastern Bering Sea, Alaska, 1909-1996.

	Herring (st)[a]									Spawn on Kelp (st)
Year	Security Cove	Goodnews Bay	Cape Avinof	Nelson Island	Nunivak Island	Cape Romanzof	Norton Sound[b]	Port Clarence	Total Harvest	Norton Sound
1909-1916	-	-	-	-	-	-	-	-	-	-
1916-1928	-	-	-	-	-	-	1,881	-	1,881	-
1929	-	-	-	-	-	-	166	-	166	-
1930	-	-	-	-	-	-	441	-	441	-
1931	-	-	-	-	-	-	86	-	86	-
1932	-	-	-	-	-	-	529	-	529	-
1933	-	-	-	-	-	-	31	-	31	-
1934	-	-	-	-	-	-	4	-	4	-
1935	-	-	-	-	-	-	15	-	15	-
1936	-	-	-	-	-	-	-	-	-	-
1937	-	-	-	-	-	-	6	-	6	-
1938	-	-	-	-	-	-	10	-	10	-
1939	-	-	-	-	-	-	6	-	6	-
1940	-	-	-	-	-	-	14	-	14	-
1941	-	-	-	-	-	-	3	-	3	-
1942-1944	-	-	-	-	-	-	-	-	-	-
1945	-	-	-	-	-	-	-	-	-	-
1946	-	-	-	-	-	-	-	-	-	-
1947-1963	-	-	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	20	-	20	-
1965	-	-	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	12	-	12	-
1967	-	-	-	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-	-	-
1969	-	-	-	-	-	-	2	-	2	-
1970	-	-	-	-	-	-	8	-	8	-
1971	-	-	-	-	-	-	20	-	20	-
1972	-	-	-	-	-	-	17	-	17	-
1973	-	-	-	-	-	-	35	-	35	-
1974	-	-	-	-	-	-	2	-	2	-
1975	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	9	-	9	-
1977	-	-	-	-	-	-	11	-	11	<1
1978	286	-	-	-	-	-	15	-	301	4
1979	424	90	-	-	-	-	1,292	-	1,806	13
1980	697	448	-	-	-	611	2,452	-	4,208	24
1981	1,173	657	-	-	-	720	4,371	-	6,921	47
1982	813	486	-	-	-	657	3,933	-	5,889	38
1983	1,073	435	-	-	-	816	4,582	-	6,906	29
1984	335	717	-	-	-	1,185	3,662	-	5,899	19[c]
1985	733	724	-	977	358	1,299	3,548	-	7,639	-
1986	751	557	-	886	511	1,865	5,194	-	9,764	-
1987	313	321	-	923	414	1,342	4,082	146	7,541	-
1988	324	483	348	775	-	1,119	4,672	80	7,801	-
1989	554	616	129	233	116	926	4,771	-	7,345	-
1990	234	455	50	-	-	329	6,439	-	7,507	-
1991	570	263	267	-	59	526	5,672	-	7,357	-
1992	834	740	451	246	27	530	-	-	2,828	-
1993	5	954	215	739	-	371	5,079	-	7,363	-
1994	-	1,062	427	717	14	456	960	-	3,636	-
1995	1,292	1,054	485	1,113	41	541	6,763	-	11,289	-
1996	1,859	1,204	820	1,030	101	752	6,220	-	11,986	-

[a] Pre-1964 harvest primarily in summer and fall for food; post 1964 harvest primarily in spring for sac roe. Wastage included.

[b] Fishery occurred some years but harvest data unavailable.

[c] Additional 3 st harvested from imported kelp (*Macrocystis* sp) not included.

Table 2. Estimated biomass and commercial harvest of Pacific herring in northeastern Bering Sea fishing districts, Alaska, 1989-1996.

Year	District	Estimated Biomass(st)	Harvest(st) Sac roe	Bait	Waste	Total	Roe%	Estimated Value $ x 1,000)	Exploitation Rate(%)
1996	Security Cove	6,867	1,795	59	5	1,859	11.6	1,251	27.1
	Goodnews Bay	6,315	1,191	13	0	1,204	12.5	895	19.1
	Cape Avinof	4,500[b]	820	0	0	820	13.4	659	18.2
	Nelson Island	6,638[b]	986	44	0	1,030	11.4	679	15.5
	Nunivak Island	4,195[b]	61	40	0	101	9.9	39	2.4
	Cape Romanzof	6,000[b]	750	1	0	752	10.6	638	12.5
	Norton Sound	27,307[b]	6,061	109	50	6,220	10.6	4,569	22.8
Total		61,822	11,664	266	55	11,986	11.2	8,730	19.4
1995	Security Cove	6,702[b]	1,292	0	0	1,292	12.3	956	19.3
	Goodnews Bay	4,219[b]	1,051	0	3	1,054	13.5	848	25.0
	Cape Avinof	3,627[b]	485	0	0	485	12.5	363	13.4
	Nelson Island	7,754	1,113	0	0	1,113	10.6	710	14.3
	Nunivak Island	4,579[b]	33	7	0	41	11.0	22	0.9
	Cape Romanzof	5,000[b]	541	0	0	541	10.1	328	10.8
	Norton Sound	37,779	6,647	116	10	6,773	10.4	4,206	17.9
Total		69,660	11,162	123	13	11,299	11.0	7,433	16.2
1994	Security Cove[c]	7,638[b]	-	-	-	-	-	-	-
	Goodnews Bay	5,679[b]	1,061	0	1	1,062	12.3	391	18.7
	Cape Avinof	2,827[b]	427	0	0	427	12.2	156	15.1
	Nelson Island	5,564	713	4	0	717	11.0	235	12.9
	Nunivak Island	4,921	14	0	0	14	8.6	4	0.3
	Cape Romanzof	5,000[b]	456	0	0	456	9.2	124	9.1
	Norton Sound	37,829	958	2	0	960	10.3	271	2.5
Total		69,458	3,629	6	1	3,636	11.1	1,181	5.2
1993	Security Cove	6,995	5	0	0	5	12.8	2	0.1
	Goodnews Bay	6,211	945	9	0	954	10.3	293	15.4
	Cape Avinof	2,837[b]	206	9	0	215	12.0	75	7.6
	Nelson Island	4,944	613	52	74	739	10.6	198	14.9
	Nunivak Island[c]	5,176	-	-	-	-	-	-	-
	Cape Romanzof	4,000[b]	371	0	0	372	9.6	110	9.3
	Norton Sound	46,549	4,713	321	45	5,079	9.9	1,411	10.9
Total		76,712	6,853	391	119	7,363	10.1	2,089	9.6
1992	Security Cove	7,773	697	127	10	834	9.2	285	10.7
	Goodnews Bay	5,572	711	29	0	740	9.5	286	13.3
	Cape Avinof	3,446	442	9	0	451	9.9	178	13.1
	Nelson Island	5,275	188	52	6	246	8.3	78	4.7
	Nunivak Island	5,703	7	20	0	27	8.5	4	0.5
	Cape Romanzof	4,500[b]	516	14	0	530	8.0	159	11.8
	Norton Sound	57,974	-	-	-	-	-	-	-
Total		90,243	2,561	251	16	2,828	9.1	990	3.1[a]
1991	Security Cove	4,434	561	9	0	570	9.3	208	12.9
	Goodnews Bay	4,387	259	4	0	263	8.9	93	6.0
	Cape Avinof	2,083	240	27	0	267	9.5	94	12.8
	Nelson Island[c]	2,385	-	-	-	-	-	-	-
	Nunivak Island	3,903	17	42	0	59	7.4	9	1.5
	Cape Romanzof	4,500[b]	451	75	0	526	8.8	210	11.7
	Norton Sound	42,854	5,465	207	125	5,797	9.3	2,414	13.5
Total		64,546	6,993	364	125	7,482	9.2	3,028	11.4
1990	Security Cove	2,650	174	60	0	234	8.7	94	8.8
	Goodnews Bay	2,577	427	28	0	455	12.2	314	17.7
	Cape Avinof	2,020[b]	49	1	0	50	12.0	35	2.5
	Nelson Island[c]	2,705	-	-	-	-	-	-	-
	Nunivak Island[c]	422	-	-	-	-	-	-	-
	Cape Romanzof	4,500[b]	318	11	0	329	8.4	155	7.3
	Norton Sound	39,384	5,353	1,026	60	6,439	8.8	3,606	16.0
Total		54,258	6,321	1,126	60	7,507	9.0	4,204	13.8
1989	Security Cove	2,830	544	10	0	554	9.4	265	19.6
	Goodnews Bay	4,040	453	162	0	616	8.4	335	15.2
	Cape Avinof	2,780[b]	90	39	0	129	8.0	54	18.7
	Nelson Island	3,320	122	100	11	233	8.5	57	7.0
	Nunivak Island	620	79	37	0	116	9.4	42	18.8
	Cape Romanzof	4,400[b]	925	1	0	926	9.3	486	21.0
	Norton Sound	25,980	4,494	247	30	4,771	9.2	2,322	18.3
Total		43,970	6,708	596	41	7,345	9.0	3,561	16.7

[a] Total exploitation rate for fishing districts which had a commercial fishery in 1992 is 8.8%.
[b] Inseason biomass estimate from poor aerial survey, therefore projected biomass or some other method of estimating biomass was used.
[c] No commercial fishery.

Table 3. Number of buyers and fishermen participating in northeastern Bering Sea Pacific herring fisheries, Alaska, 1989-1996.

Year	District	Number of Buyers	Number of Fishermen		
			Gilllnet	Beach Seine [a]	Totals
1996	Security Cove	14	326	-	-
	Goodnews Bay	5	182	-	-
	Cape Avinof	2	161	-	-
	Nelson Island	3	109	-	-
	Nunivak Island	2	24	-	-
	Cape Romanzof	3	63	-	-
	Norton Sound	10	281	6	287
1995	Security Cove	12	106	-	-
	Goodnews Bay	4	127	-	-
	Cape Avinof	2	93	-	-
	Nelson Island	4	100	-	-
	Nunivak Island	2	13	-	-
	Cape Romanzof	2	49	-	-
	Norton Sound	6	209	6	215
1994	Security Cove	0	0	-	-
	Goodnews Bay	2	103	-	-
	Cape Avinof	1	85	-	-
	Nelson Island	3	104	-	-
	Nunivak Island	1	12	-	-
	Cape Romanzof	2	55	-	-
	Norton Sound	7	212	3	215
1993	Security Cove	1	9	-	-
	Goodnews Bay	3	63	-	-
	Cape Avinof	1	97	-	-
	Nelson Island	1	73	-	-
	Nunivak Island	0	0	-	-
	Cape Romanzof	2	41	-	-
	Norton Sound	6	256	7	263
1992	Security Cove	6	58	-	-
	Goodnews Bay	3	78	-	-
	Cape Avinof	2	121	-	-
	Nelson Island	3	85	-	-
	Nunivak Island	1	14	-	-
	Cape Romanzof	2	73	-	-
	Norton Sound	0	0	-	-
1991	Security Cove	6	52	-	-
	Goodnews Bay	2	103	-	-
	Cape Avinof	1	137	-	-
	Nelson Island	0	0	-	-
	Nunivak Island	2	17	-	-
	Cape Romanzof	2	80	-	-
	Norton Sound	8	272	7	279
1990	Security Cove	9	52	-	-
	Goodnews Bay	3	126	-	-
	Cape Avinof	1	101	-	-
	Nelson Island	0	0	-	-
	Nunivak Island	0	0	-	-
	Cape Romanzof	4	95	-	-
	Norton Sound	8	357	8	365
1989	Security Cove	8	110	-	-
	Goodnews Bay	6	138	-	-
	Cape Avinof	3	147	-	-
	Nelson Island	4	162	-	-
	Nunivak Island	3	45	-	-
	Cape Romanzof	6	115	-	-
	Norton Sound	9	351	6	357

[a]Gear prohibited in all districts except Norton Sound and Port Clarence

Table 4. Pacific herring subsistence harvest (st) and effort data from selected northeastern Bering Sea areas, Alaska, 1978-1996.[a]

Village	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
								Nelson Island											
Tununak	38	34	65	40	48	94	-	43	63	48	49	47	54	21	32	45	42	30	25.8
Umkumiut	11	8	3	10		-	-	-	-	[c]	[c]	[c]	[c]	[c]	[c]	-	-	-	-
Toksook Bay	37	51	29	14	35	-	-	46	70	51	58	52	46	40	43	23	53	46	41.5
Nightmute	-	-	-	-	-	-	-	3[b]	21	15	16	15	18	8	10	9	13	13	16.2
Newtok	-	-	-	-	-	-	-	7[b]	13	10	12	10	8	1	7	6	9	9	11.5
Total	86	93	97	64	83	94	-	99	167	124	136	124	126	70	92	82	117	98	95
No. Fishing Families	83	54	70	93	65	43	-	65[b]	72[b]	96	104	[b]	100	85	97	89	-	91	96
								Nunivak Island											
Mekoryuk	-	-	-	-	-	-	-	<1	<1	-	-	-	5	4	4	2	-	-	-
No. Fishing Families	-	-	-	-	-	-	-	11	6[b]	-	-	-	19	20	17	16	-	-	-
								Other Kuskokwim Delta											
Chefornak	-	-	-	-	-	-	-	13[b]	-	14	-	-	-	-	-	-	-	-	-
Kipnuk	-	-	-	-	-	-	-	9	-	14	-	-	-	-	-	-	-	-	-
Kongiganak	-	-	-	-	-	-	-	3	2[b]	-	-	-	-	-	-	-	-	-	-
Kwigillingok	-	8	13	-	13	-	-	5	-	-	-	-	-	-	-	-	-	-	-
Total	-	8	13	-	13	-	-	30	2	28	-	-	-	-	-	-	-	-	-
No. Fishing Families	-	22	19	-	21	-	-	55[b]	12[b]	49	-	-	-	-	-	-	-	-	-
								Yukon Delta											
Scammon Bay	1	6	3	8	4	3	4	2	2	1	2	1	2	1	1	3	1	1	1
Chevak	-	2	4	2	2	1	3	2	1	1	2	<1	1	<1	<1	<1	2	1	<1
Hooper Bay	4	3	4	4	5	5	4	4	4	1	4	2	6	2	2	2	3	4	1
Total	5	11	11	14	11	9	11	8	7	3	7	3	8	3	4	5	6	6	2
No. Fishing Families	29	84	61	46	43	37	47	44	41	39	32	24	32	18	30	42	48	42	17

[a] Subsistence survey results are believed to accurately reflect harvest trends however, reported catches reflect minimum figures since all fishermen cannot be contacted.
[b] Fishing families were not interviewed or only a portion of fishing families were interviewed as catch was enumerated while on drying racks.
[c] Umkumiut effort included with Tununak.

Table 5. Pacific herring estimated biomass in the northeastern Bering Sea, Alaska, 1978-1996.

	Herring (st)								
Year	Security Cove	Goodnews Bay	Cape Avinof	Nelson Island	Nunivak Island	Cape Romanzof[a]	Norton Sound	Port Clarence	Total Biomass
1978	1,323	441	-	5,952	805	2,976	5,291	-	16,788
1979	21,495	7,385	-	5,952	-	2,976	7,716	-	45,524
1980	1.213	1,213	-	5,952	-	2,976	8,377	-	19,731
1981	8,267	4,299	-	3,968	19	4,850	22,360	-	44,331
1982	5,071	2,646	-	3,968	-	4,850	19,403	-	33,951
1983	6,393	3,197	-	7,275	7,606	5,512	6,841	-	58,092
1984	5,071	4,079	-	11,023	6,695	6,063	21,475	-	56,079
1985	4,900	4,300	2,000	9,500[b]	5,700[b]	7,000	20,000	-	51,400
1986	3,700[b]	3,000[b]	-	7,300[b]	6,000	7,500	28,100	-	55,600
1987	2,300[b]	2,000[b]	1,225	8,100	4,400[b]	7,200	32,370	932	57,332
1988	4,906	4,479	4,108	7,152	2,800[b]	6,600	33,924	788	64,757
1989	2,830	4,040	2,780[b]	3,320	620	4,400	25,981	-	43,970
1990	2,650	2,577	2,020[b]	2,705	422	4,500	39,384	-	54,258
1991	4,434	4,387	2,083	2,385	3,903	4,500	42,854	-	64,546
1992	7,773	5,572	3,446	5,275	5,703	4,500	57,974	1,652	91,895
1993	6,995	6,211	2,837[b]	4,944	5,176	4,000	46,549	822	77,534
1994	7,638[b]	5,679[b]	2,827[b]	5,564	4,921	5,000	37,829	92	69,550
1995	6,702[b]	4,219[b]	3,627[b]	7,754	4,579[b]	5,000	37,779	-	69,660
1996	6,867	6,315	4,500[b]	6,638[b]	4,195[b]	6,000	27,307[b]	-	61,822

[a] Biomass estimate based on limited aerial survey information, spawn deposition, age composition, and CPUE from commercial and test fisheries.

[b] Unacceptable aerial survey conditions for estimating herring biomass, therefore projected biomass or some other method of estimating biomass was used.

Table 6. Summary of Pacific herring commercial harvest by fishing period for northeastern Bering Sea fishing districts, Alaska, 1996.

District	Subdistrict Sec/Area	Gear	Period	Date	Time	Total Hours	Harvest (st)
Security Cove		Gillnet	1	5/11	1300-1500	2.0	411.0
			2	5/12	1500-1830	3.5	1,443.0
					Total	5.5	1,854.0[a]
Goodnews Bay		Gillnet	1	5/16	1800-2200	4.0	71.1
			2	5/17	1900-2300	4.0	366.3
			3	5/18	0800-1200	4.0	32.9
			4	5/19	0800-1200	4.0	25.4
			5	5/19-20	2100-0100	4.0	83.1
			6	5/20	0930-1330	4.0	78.3
			7	5/21	1000-1400	4.0	122.7
			8	5/22	1030-1430	4.0	52.7
			9	5/23	1100-1400	3.0	23.2
			10	5/24	1100-1600	5.0	152.3
			11	5/25	1230-1630	4.0	196.5
					Total	44.0	1,204.5
Cape Avinof		Gillnet	1	5/19	0800-1400	6.0	6.0
			2	5/19-20	2100-0100	4.0	5.0
			3	5/20	0900-1300	4.0	3.7
			4	5/20-21	2200-0200	4.0	1.2
			5	5/21	1000-1600	6.0	10.7
			6	5/21-22	2300-0300	4.0	4.3
			7	5/22	1100-1700	6.0	59.2
			8	5/23	1100-1900	8.0	215.7
			9	5/24	0000-0600	6.0	284.7
			10	5/25	1300-1700	4.0	101.3
			11	5/26	1500-1800	3.0	127.8
					Total	55.0	819.6
Nelson Island		Gillnet	1	5/16	0700-1200	5.0	179.1
			2	5/16-17	2100-0100	4.0	80.6
			3	5/17	0900-1400	5.0	180.7
			4	5/17-18	2100-0300	6.0	340.2
			5	5/18	1000-1500	5.0	250.0
					Total	25.0	1,030.6
Nunivak Island		Gillnet	1	5/14	0600-1000	4.0	20.1
			2	5/14	1800-2400	6.0	34.2
			3	5/16	0900-1500	6.0	8.4
			4	5/17	0700-1300	6.0	0.0
			5	5/24	1400-2200	8.0	28.4
			6	5/27-6/5	1400-2200	224.0	9.8
					Total	254.0	100.9
Cape Romanzof		Gillnet	1	5/17	0100-0200	1.0	0.4
			2	5/18	1430-1730	3.0	103.4
			3	5/19	0200-0600	4.0	1.8
			4	5/19	1530-1800	2.5	137.9
			5	5/20	0400-0700	3.0	2.2
			6	5/21	0500-0800	3.0	1.3
			7	5/21	1500-1900	4.0	97.9
			8	5/22	0430-0800	3.5	63.8
			9	5/22	1500-2100	6.0	281.7
			10	5/25	1800-2200	4.0	61.3
					Total	34.0	751.7
Norton Sound	SD 1, 2, 3	Gillnet	1	5/24	1200-1700	5.0	3,042.3
	SD 1, 2, 4		2	5/25	1100-2000	9.0	2,538.8
					Total	14.0	5581.1[b]
	SD 1, 2, 3, 5	Beach Seine	1	5/25	0700-1000	3.0	588.9
					Total	3.0	588.9

[a] Does not include 5 tons of waste.

[b] Does not include 50 tons of waste.

Table 7. Projections of Pacific herring spawning biomass and harvest for commercial fishing districts in the northeastern Bering Sea, Alaska, 1997.

		1997 Projection[a]		
District	Threshold	Biomass (st)	Exploitation Rate (%)	Harvest (st)
Security Cove	1,200	4,625	20	925
Goodnews Bay	1,200	4,752	20	950
Cape Avinof	500	3,737	15	561
Nelson Island	3,000	5,094	15	764
Nunivak Island	1,500	3,801	20	760
Cape Romanzof	1,500	4,508[b]	20	902
Norton Sound	7,000	19,675	20	3,935
Port Clarence	-	-	-	165[c]
Totals		46,192		8,962

[a] Preseason projection. Biomass and harvest may be adjusted based on inseason estimates.

[b] Projection from estimated 1996 relative biomass which was based on 1996 aerial surveys, spawn deposition, age composition, and the CPUE from commercial and test fisheries.

[c] Harvest guideline of 165 st (150 mt).

Table 8. Herring harvest by gear type and subdistrict, Norton Sound District, 1982-1996.

NORTON SOUND HERRING CATCHES

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
GILLNET HARVEST (tons)															
St. Michael	2,062	434	—	1,538	2,560	2,214	3,215	2,927	4,491	—	—	2,288	249	2,359	3,074
Unalakleet	946	1,264	—	95	—	—	42	10	618	731	—	120	12	374	—
Cape Denbigh	925	2,692	3,244	1,599	2,420	1,545	1,211	1,414	923	4,419	—	1,659	619	1,467	2,507
Elim	—	65	—	147	—	—	6	—	—	—	—	225	41	1,774	—
Golovin	—	85	—	—	—	—	—	—	—	—	—	—	—	191	
total [a]	3,933	4,540	3,244	3,379	4,980	3,759	4,474	4,351	6,032	5,150	[b]	4,291	921	6,166	5,581
SEINE HARVEST (tons)															
St. Michael (beach)	—	—	—	—	—	4	45	329	6	—	—	—	1	—	—
Unalakleet (beach)	—	—	—	93	—	—	58	50	332	149	—	467	24	230	111
Cape Denbigh (beach)	—	41	327	76	30	293	96	11	9	373	—	222	15	57	325
Elim (beach)	—	—	—	—	185	—	—	—	—	—	—	54	—	334	153
Cape Denbigh (purse)	—	—	—	—	—	26	—	—	—	—	—	—	—	—	—
total [a]	0	41	327	169	215	323	198	390	347	522	[b]	743	40	621	589
TOTAL HARVEST (tons) [a]	3,933	4,581	3,571	3,548	5,195	4,082	4,672	4,741	6,380	5,672	0	5,034	961	6,787	6,170
Percent of total harvest															
Gillnet Harvest	100.0	99.1	90.8	95.2	95.9	92.1	95.8	91.8	94.6	90.8		85.2	95.9	90.9	90.5
Seine Harvest	0.0	0.9	9.2	4.8	4.1	7.9	4.2	8.2	5.4	9.2		14.8	4.1	9.1	9.5

[a] Totals do not include waste.
[b] No commercial fishery.

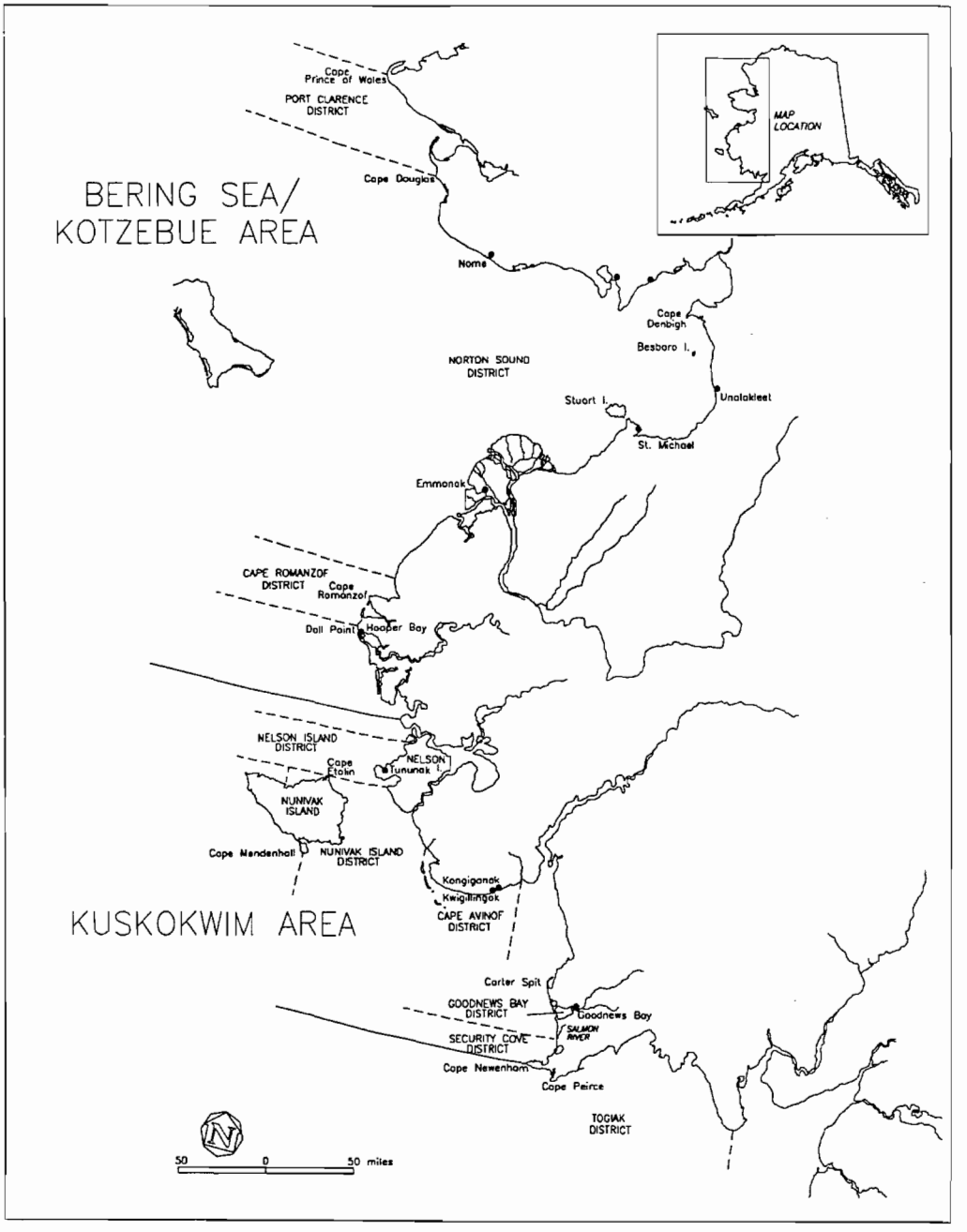

Figure 1. Commercial herring fishing districts within the Arctic-Yukon -Kuskokwim Region, Alaska, 1996.

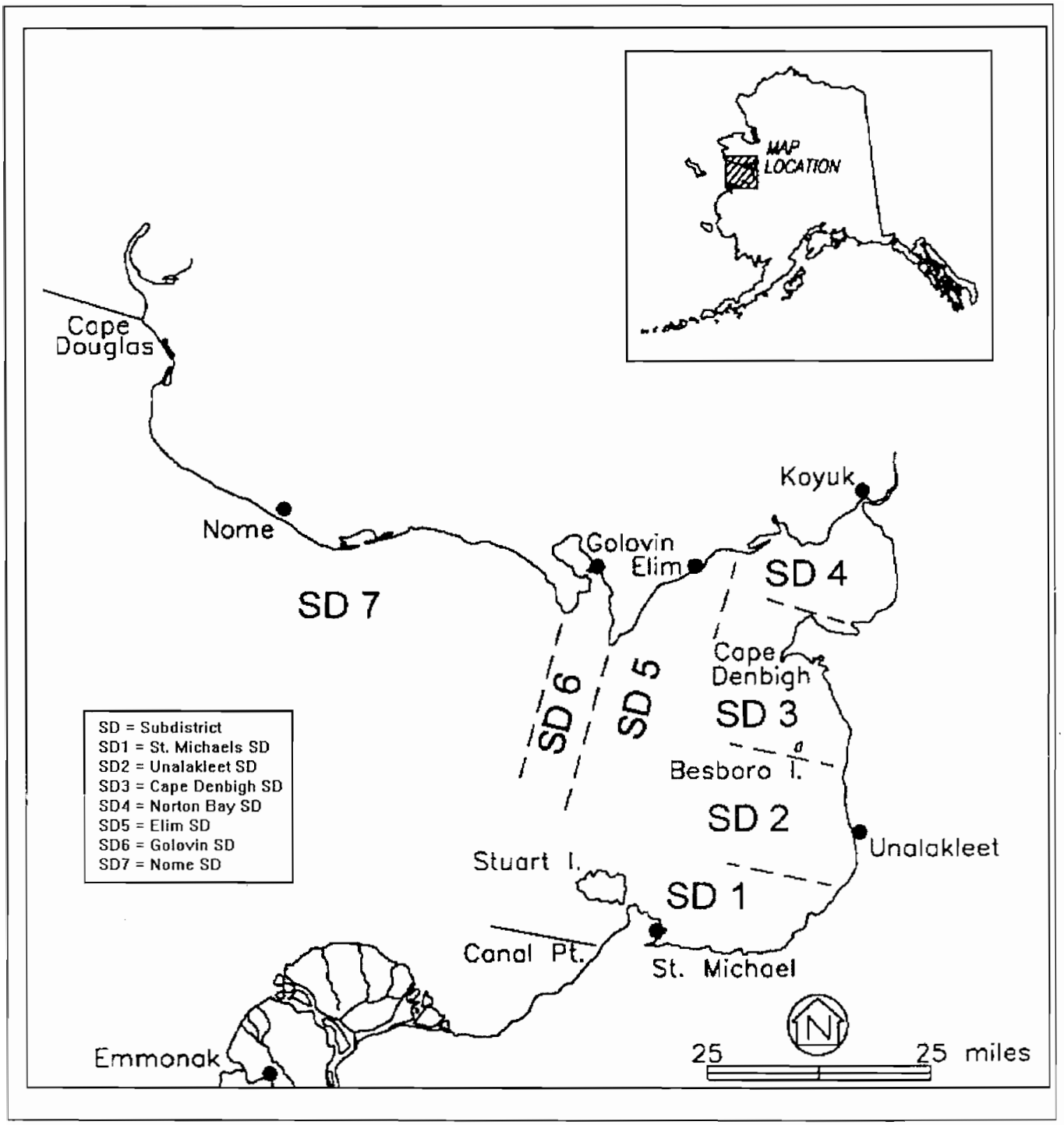

Figure 2. Norton Sound commercial herring subdistricts.

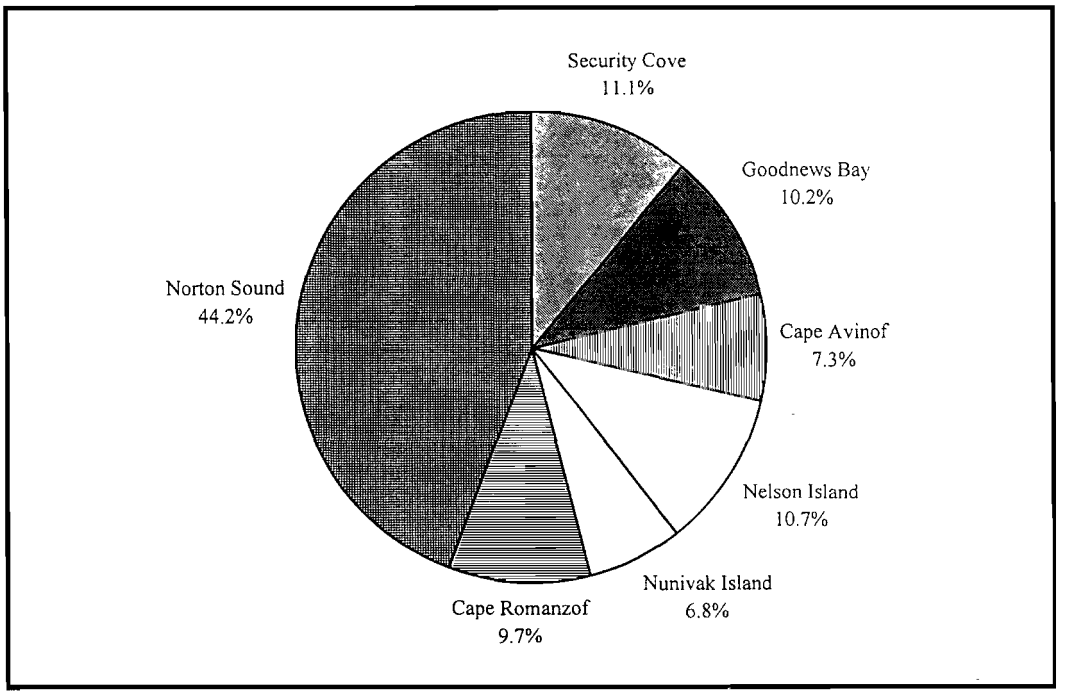

Figure 3. Pacific herring run biomass distribution by fishing district, Arctic-Yukon-Kuskokwim Region, Alaska, 1996.

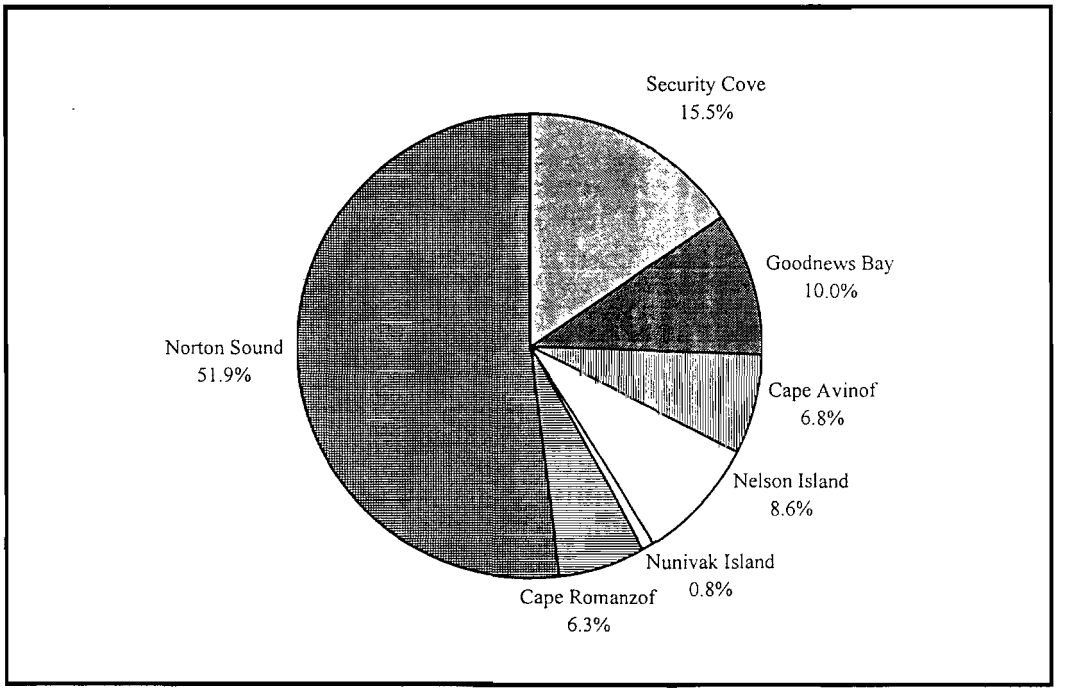

Figure 4. Pacific herring commercial harvest distribution by fishing district, Arctic-Yukon-Kuskokwim Region, Alaska, 1996.

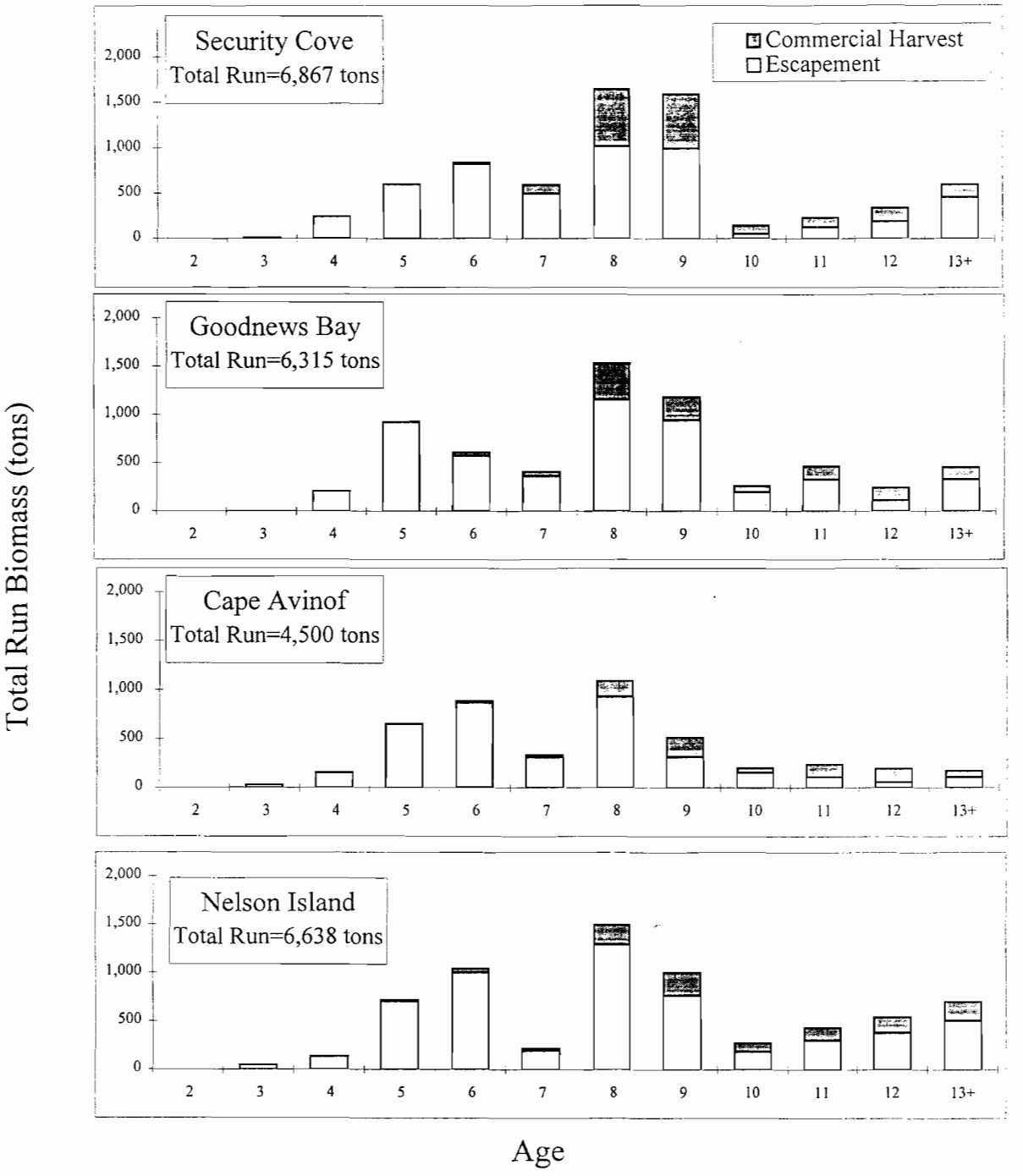

Figure 5. Age composition of Pacific herring for the escapement and harvest for the Security Cove, Goodnews Bay, Cape Avinof, and Nelson Island Districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 1996.

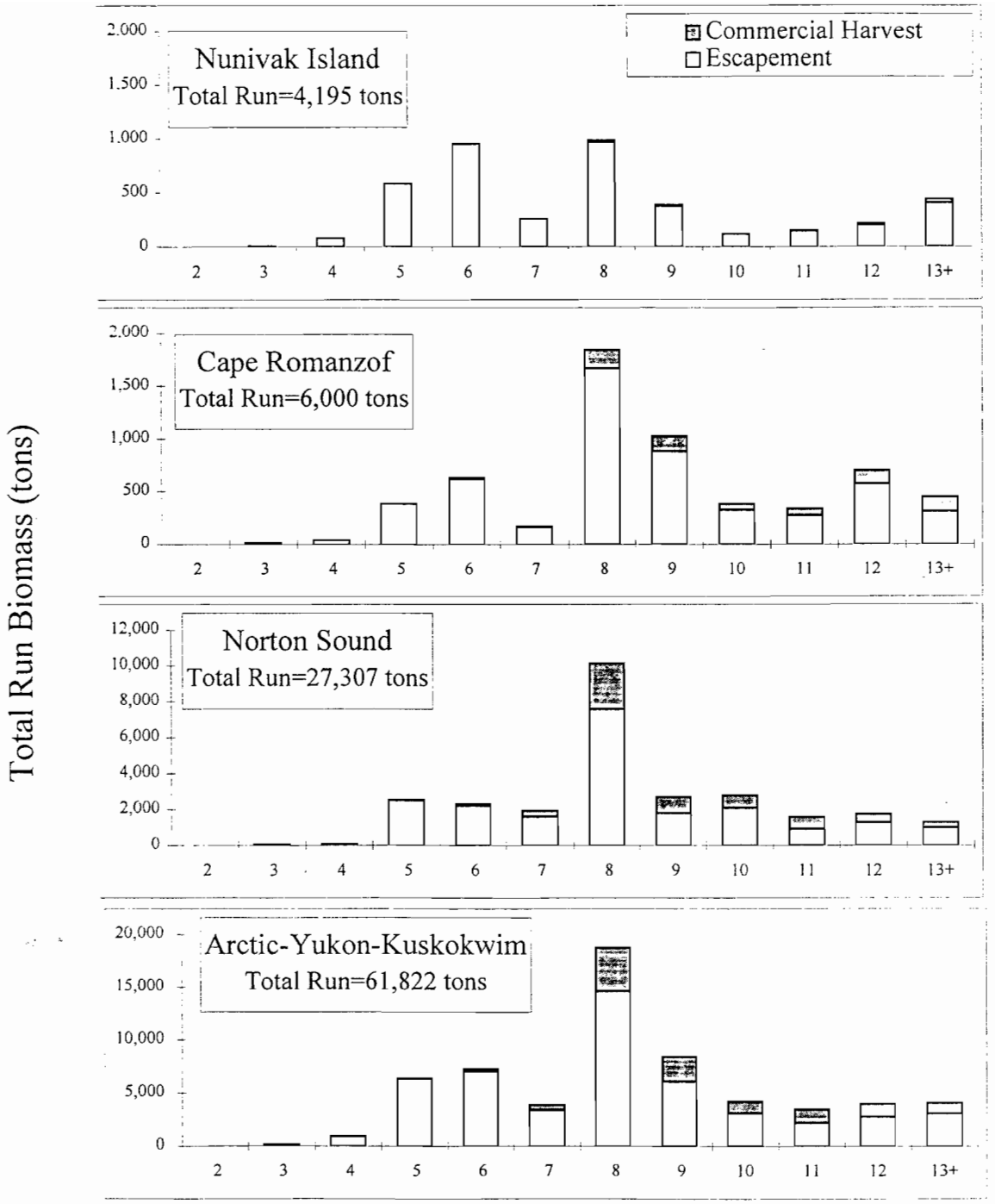

Figure 6. Age composition of Pacific herring for the escapement and harvest for the Nunivak Island, Cape Romanzof, and Norton Sound Districts, and the combined Arctic-Yukon-Kuskokwim Region, Alaska, 1996.

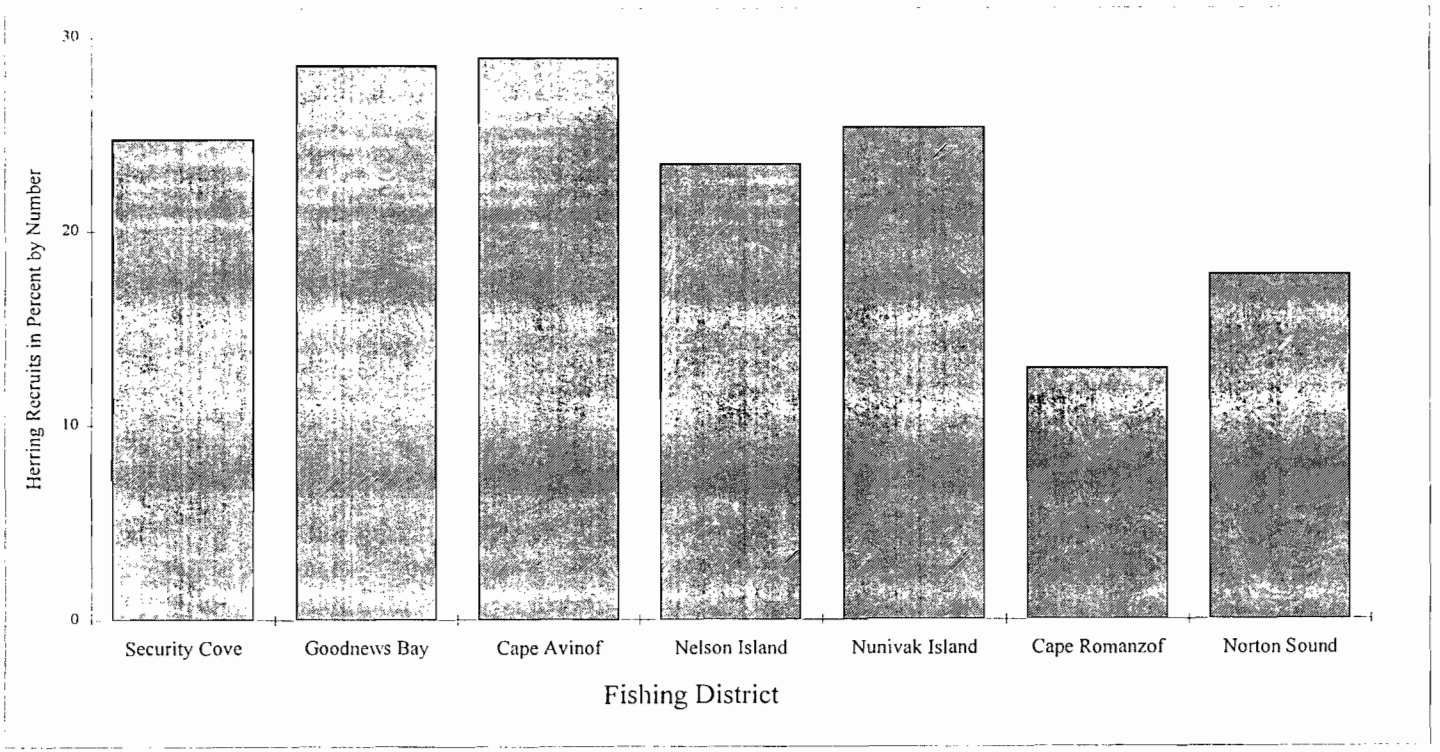

Figure 7. Pacific herring recruits (ages 2 through 5) for commercial fishing districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 1996.

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